PROJECT FACT SHEET

CONTRACT TITLE: Novel CO2-Thickeners for Improved Mobility Control/Advanced Recovery Concepts Awards

ID NUMBER: DE-AC26-98BC15108

B&R CODE: AC1005000

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PROJECT SITE
CITY: Pittsburgh **STATE:** PA
CITY: **STATE:**
CITY: **STATE:**

CONTRACT PERFORMANCE PERIOD:
9/29/1998 to 9/28/2001

PROGRAM: Supporting Research
RESEARCH AREA:
PRODUCT LINE: RLE

FUNDING (1000'S)	DOE	CONTRACTOR	TOTAL
PRIOR FISCAL YRS	247	97	344
FISCAL YR 1999	250	84	334
FUTURE FUNDS	240	87	327
TOTAL EST'D FUNDS	737	268	1005

OBJECTIVE: The research is to increase the viscosity of the dense carbon dioxide by 1-2 orders of magnitude using dilute concentrations of low MW gelling agents. The following guidelines will be employed. (1) The thickener should be evaluated only in carbon dioxide, not in organic liquids during screening. (2) The thickener should be designed specifically for use in CO2. This should increase CO2-solubility while reducing or eliminating the need for a cosolvent. (3) The thickener will be a relatively low molecular weight end-functionalized polymer or extremely low molecular weight compounds that form associative or H-bonded aggregates in solution, rather than an extremely high molecular weight polymer. The research can be classified into three distinct topics, thickener synthesis and characterization, phase behavior studies of carbon dioxide/thickeners mixtures, and viscosity measurements of CO2/thickener solutions.

PROJECT DESCRIPTION:
Background:
Work to be Performed: The research will be accomplished by completing the following six tasks:(1)Carbon Dioxide Thickener Synthesis, (2) Carbon Dioxide Thickener Characterization,(3)Carbon Dioxide Solubility Testing, (4)Viscosity Measurements, (5) Reporting-Data Analysis, Reduction and Correlation, and(6)Technology Transfer

PROJECT STATUS:
Current Work: New Contract
Scheduled Milestones:
Quarterly and annual reports

Accomplishments: Dr. Robert Enick, Dr. Eric Beckman and their PhD student ChunMei Shi presented their first findings on carbon dioxide-thickeners at the Annual Meeting of the Americal Institute of Chemical Engineers, Nov. 15-20, 1998, Miami Beach, FL. The talk, entitled "Increasing the Viscosity of Carbon Dioxide with Telechelic Ionomers" was presented by C.-M. Shi. The talk detailed two carbon dioxide thickeners. The first was a relatively low molecular weight telechelic ionomer that tripled that carbon dioxide viscosity at a concentration of 4 wt%. The second was a high molecular weight polymer that doubled the viscosity of carbon dioxide at a concentration of 5wt%. The results for the telechelic ionomer were the first documented increases in carbon dioxide viscosity using relatively low molecular weight compounds (telechelic ionomers) without the need for a co-solvent.

Subsequently, Dr. Enick and Dr. Beckman identified two additional types of carbon dioxide thickeners. A semi-fluorinated trialkyltin fluoride has been shown to triple the viscosity of liquid carbon dioxide at a concentration of about 4wt%. The degree of fluorination of the compound is being lowered to reduce the concentration required to obtain this level of viscosity enhancement while retaining carbon dioxide solubility. Random fluorocarbon-hydrocarbon copolymers in concentrations of 1-5 wt% have exhibited 10-100 fold increases in carbon dioxide viscosity as measured with a close-clearance, falling cylinder viscometer.

In the first six months of this project, three types of carbon dioxide thickeners have been identified, fluorinated telechelic ionomers, semi-fluorinated trialkyltin fluorides and fluorocarbon-hydrocarbon copolymers. Each have exhibited viscosity increases that indicate that the molecules are self-assembling in solution to form macromolecules capable of increasing viscosity. Cosolvents are not required for any of these thickeners.